1991 McNARY DAM SMOLT MONITORING PROGRAM

ANNUAL REPORT

by

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Prepared For

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1.0 INTRODUCTION

The Washington Department of Fisheries assumed responsibility for the Smolt Monitoring Program at McNary Dam in 1990. This work was continued in 1991 and this report summarizes the 1991 McNary smolt monitoring season.

The first 1991 fingerling sample was processed at 0700 hours on March 26. The 1991 smolt monitoring season was unique in that the monitoring period was extended concurrent with a WDF fallback research project which was conducted at the McNary juvenile fish facility. This project required that the submersible traveling screens remain installed after November 1 when they would normally be removed for maintenance and that the McNary bypass and collection system remain operational through 0700 hours on December 16. The final 24 hour sample for the 1991 smolt monitoring season was processed at 0700 hours on December 16 and a final separator clean-out followed immediately thereafter.

Overall, a total of 560,559 juvenile salmonids were anesthetized and individually counted and examined for brands and scale loss by the McNary Smolt Monitoring crew in 1991.

2.0 MODIFICATIONS

2.1 Over-anesthetization of Sample Fish

Proper anesthetization of juvenile salmonids is a difficult task. The anesthetic concentration and the length of time that juvenile fish are left in anesthetic must be adjusted throughout the sampling season in response to changes in species composition, smolt condition, and water temperature. A fine line often divides the under- and over-anesthetization of fish and there are problems which result from either condition. Fish that are under-anesthetized are difficult to handle and this reduces the ability of fish handlers to detect freeze brands which is a primary function of the program. Fish that are difficult to handle are also difficult to properly mark. Over-anesthetized fish simply die.

In 1990 concern was expressed that sample fish had been over-anesthetized on several occasions during the spring by inexperienced SMP personnel operating the pre-anesthetic system. To evaluate this, 1990 raceway 1 tailscreen mortality counts were entered on a Lotus 123 spreadsheet and summarized to provide an index of the post-handling mortality rate (Wagner, 1990). As this had not been summarized in past years, data from the 1987 through 1989 seasons was similarly treated and a raceway 1 mortality index database was created. This database was continued in 1991 (Table 1). The 1991 raceway 1 mortality index was slightly higher than that recorded in 1990 and similar to the index rates calculated for 1989 and 1988.

A bypass control tank mortality database was also begun in 1991. Unlike the raceway 1 mortality index, the control tank mortality counts are not based upon tailscreen recoveries only but are, at least in theory, complete post handling mortality counts of sample fish which are designated for bypass. Control tank mortality averaged 0.60% in 1991 (Table 1).

Additional steps were taken in 1991 to minimize post handling mortality. These included:

A) A second anesthesiologist was hired during the spring peak outmigration period. This position was created to provide relief and assistance for the primary anesthesiologist.

B) A veteran fish handler was required to document daily smolt condition related to anesthetization and to immediately notify the anesthesiologist and/or the SMP biologists if deteriorated smolt condition was observed during the counting process.

C) An additional fish handler was hired during the spring outmigration peak. This was done to reduce the processing time and the length of time that fish were held in the re-circulating anesthetic system.

Problems Related To Anesthetization

On May 18, control tank mortality rose to 8.78% which was by far the highest rate recorded for the season and was considerably higher than either the system (0.2%) or sample tank (1.5%) mortality rates calculated on that day. Over-anesthetization is one possible explanation for this mortality increase although the senior fish handler rated fish quality due to anesthetization as good and the raceway 1 mortality index was only 0.08% on May 18. The problem could not be attributed to the FPC travel time marking program as fish were not marked on May 18. The density at which fish were held in the control tank was also not excessive. It was noted that the general quality of the sample fish was very poor. It is likely that one of the four bypass groups (subyearling chinook, yearling chinook, coho, sockeye) entered the sampling system in poor condition and the additional stress resulting from the anesthetization and handling process resulted in the high mortality. This apparently was not the case for steelhead which were transferred to and held in raceway 1 and had a very low rate of mortality.

During the final two days of the subyearling chinook marking program (see 3.2) a total of 128 smolts (two full dip nets) failed to revive after pre-anesthetization in the 70 degree facility water. This was a frustrating situation as fish from each segment of the sample did not show the same anesthetic tolerance (i.e., at the same concentration of anesthetic several

dipnets of fish would be handled and marked without incident followed by a dipnet of fish which failed to revive). To eliminate this, both the re-circulating anesthetic and pre-anesthetic concentrations were reduced. This effectively minimized mortality but the sample fish also revived quickly in the sample trough and were very difficult to examine and mark.

2.2 Full Sample Descaling

Prior to 1990, all descaling rates used to index the condition of the daily fingerling collection at McNary Dam were based upon 50 to 200 fish sub-samples which were recorded daily by an FTOT biologist. This data was disseminated to tribal, state and federal agencies and to the FPC. In July and August of 1990, the SMP crew was instructed to count the number of descaled fish from each entire daily sample. The "full sample" descaling rate generated from this allowed better detection of daily changes in smolt condition and the extra counting did not significantly increase the time required to process the fish.

In 1991, tabulators and brackets were installed at each counting station on the sampling trough so that full sample descaling counts could be obtained throughout the season. Full sample descaling rates were reported daily to the FPC during 1991 and are summarized for the season in Table 2.

3.0 RESEARCH

3.1 FPC Travel Time

In 1991 the Fish Passage Center funded a private contractor to freeze brand yearling chinook and steelhead for travel time evaluation to John Day Dam. A total of 32,218 yearling chinook were branded and bypassed (Table 3). Overall, 73.5% of the yearling chinook which were handled for this program were markable. Yearling chinook were unmarkable most often due to scale loss.

A total of 21,414 steelhead were also branded and bypassed for travel time evaluation (Table 4). This was 77.8% of the total number handled for this program. Steelhead were most often unmarkable because they had been previously branded.

3.2 USFWS Early Life History

The United States Fish and Wildlife Service contracted the Washington Department of Fisheries to freeze brand, coded wire tag, and adipose clip subyearling chinook for early life history evaluation. A total of 105,088 zero age chinook were marked and bypassed for this program (Table 5). An additional 3,000 were held for delayed mortality evaluation and transported.

The marking was conducted from June 20 through August 3 and was split into three 36,000 fish replicates. The first, second, and third replicates approximated the early, middle, and late segments of the outmigration respectively (Figure 1).

The June 28 release group which is listed in Table 5 as having been branded RA2K3 was actually branded LA2K3 similar to the July 26 release group. This error was detected through subsequent recovery at John Day Dam of LA2K3 brands prior to the July 26 release. A unique external mark is required for each release group to determine the relationship between travel time and flow. In this case the two similarly branded release groups can be distinguished due to the 28 days between the two releases (i.e., most of the first release should have been recovered at John Day Dam prior to the second release). However, this is a potentially serious error which can hopelessly confound travel time estimates. A strict cross-check format must be implemented to prevent this in the future. The format used this year at McNary was:

1) At the start of the day, the marking pots were labeled with the brand type, location, and rotation.

2) At the conclusion of the day, a daily marking record form was completed which included the brand type, location, and rotation as indicated on the label.

3) A label from one of the two marking pots was then removed and attached to a garbage can containing 50 to 100 fish which were held for 48 hour delayed mortality and tag loss evaluation.

4) Two days later the fish would be removed and examined for mortality and tag loss. This information would then be logged along with the brand type, location, and rotation as indicated on the attached label.

Under this format it is difficult to see how the June 28 release group could have been marked on the wrong side. Both the daily marking record form and the delayed mortality and tag loss log list the June 28 release as RA2K3. There are only two possible ways this error could have occurred: case 1 - the brand location was twice incorrectly transcribed, or case 2 - two experienced fish branders ignored the brand label which was placed immediately in front of them and branded 5,092 fish on the wrong side. Both cases are unlikely, however one or the other did apparently occur this past season.

3.3 USFWS Smoltification and Travel Time

This year the USFWS sacrificed 756 yearling chinook, 621 subyearling chinook, 701 hatchery steelhead, and 127 wild steelhead to measure physiological indices of smoltification.

These fish were provided by the McNary SMP.

3.4 WDF Wild Subyearling Chinook Marking

Objectives

In June, wild subyearling chinook were captured at the Hanford Reach and freeze branded or PIT tagged for the McNary Smolt Monitoring Program. This pilot study had two objectives: 1) supplement the USFWS Smoltification and Travel Time physiological sampling with wild subyearling chinook which could be identified upon recovery at McNary Dam (freeze brands), and 2) index the arrival timing of wild subyearling chinook to McNary Dam (freeze brands, PIT tags).

Methods

The field work was performed in conjunction with a WDF Pacific Salmon Treaty CWT marking program and was a cooperative effort. The WDF Battle Ground Office personnel were assisted by a USFWS volunteer and captured the fish with stick seines and beach seines. The Yakima Indian Nation and Confederated Tribes of Umatilla also assisted in capturing fish. The WDF Tumwater CWT marking trailer crew performed the freeze branding. The NMFS provided the PIT tagging equipment and the PIT tag technical expertise. The McNary WDF SMP personnel assisted in the capturing of fish and were trained to PIT tag. USFWS personnel sacrificed wild fish at the marking site to measure physiological parameters.

The capturing crew used jet boats to access the shallow areas of the Hanford Reach where wild zero age upriver bright fall chinook were seined. The captured fish were held in garbage cans and then transferred to the tagging site (ferry landing) where a WDF CWT marking trailer was located. At the ferry landing the fish were either sorted and marked immediately or held for a brief time in net pens until they could be sorted and marked. Fish that were designated to be marked for the Smolt Monitoring Program were hand sorted by the WDF CWT marking trailer crew. Only fish 55mm or greater in fork length were to be PIT tagged or freeze branded. All fish were released on the same day that they were marked except for those fish which were held for delayed mortality evaluation. The Priest Rapids hatchery release of zero age chinook had to be delayed until the conclusion of this program so that only wild fish would be captured and marked.

The general PIT tagging plan was to tag and release a total of 2,000 fish in 1 to 2 days and then recover a portion of these fish at McNary Dam. The NMFS provided the PIT tagging equipment, a paneled truck, and a biologist trained in the application of PIT tags to assist in the field work. The truck containing the equipment was parked immediately next to the WDF CWT trailer at

the ferry landing. Fish were brought by boat to the trailer where they were sorted and then transferred to the truck. The fork length of each fish was recorded as the fish were tagged. The PIT tagged fish were then held in a freshwater trough along with fish from the CWT marking program. At the end of the day all marked fish were transferred by boat several miles downstream from the ferry landing and released. At the recovery site (McNary Dam), the tagged fish were passively interrogated as they exited the separator. The arrival timing of these fish was determined by counting the number of detections per day.

The general freeze branding plan was to mark and release a total of 10,000 fish in 1,250 fish per day groups for subsequent recovery at McNary Dam. Each group was to be given a unique brand. The freeze branding was conducted inside the CWT marking trailer. The fish were sorted, branded, and held with fish from the CWT marking program and then released. At the recovery site, a sample of the freeze branded fish were individually anesthetized and examined by the McNary SMP and then sacrificed by USFWS biologists to measure physiological indices of smoltification. Fork lengths were also recorded for each branded fish that was sampled. The arrival timing of these fish was determined from daily collection estimates which are equal to the number of branded fish sampled per day divided by the daily sampling rate.

The information collected at release and recovery for the two types of marks is summarized below:

Release Data

PIT Tags
- individual tag number
- number of fish released
- individual fish length

Freeze Brands
- brand character, location, and rotation by daily mark group
- number of fish released

Recovery Data

PIT Tags
- individual tag number
- exact time of recovery

Freeze Brands
- hand count of all branded fish sampled within each 24 hour sampling period.
- length of each branded fish

Recovery Estimates

PIT Tags
- exact count of all detections

Freeze Brands sample count expanded by the daily sampling rate

The 24 hour sampling period at McNary Dam runs from 0700 hours to 0700 hours. Peak passage dates and daily passage indices are based upon this 24 hour time period for both PIT tagged fish and freeze branded fish (i.e., a PIT tagged fish detected at 0701 hours on July 12 would be included in the daily collection estimate dated July 13). Daily passage indices were calculated for both types of marks. The passage index is the collection count (PIT tags) or collection estimate (freeze brands) expanded by the proportion of the McNary project discharge which was passed over the spillway.

Results - PIT Tags

A total of 2,018 wild subyearling chinook were PIT tagged on June 6 and June 7 (Table 6). These fish ranged from 51mm to 80mm and had a mean fork length of 62.3mm (Figure 2). Slight error in the hand sorting process resulted in 1.3% of the PIT tagged fish having fork lengths less than the 55mm minimum criterion. Direct mortality due to the handling and tagging process was 2.7% (Table 6). One hundred fish from the June 6 release group were held for 24 hour delayed mortality evaluation and released on June 7. Delayed mortality for this group equalled 2.0%. Mortalities were generally the smaller fish (mean fork length = 60.9mm).

The first PIT tagged fish arrived at McNary Dam at 04:14 hours on June 10 or 2.7 days after it was released. The passage index peaked on July 13. The last PIT tag detection occurred at 08:16 hours on August 28 (81.8 days after release). Only 15.2% of those tagged were detected at the McNary collection facility (Table 6). An additional 2.2% are estimated to have passed over the spillway. Generally, the fish that were the largest at release were the first to arrive at the McNary collection facility and the smaller fish were the last to arrive (Figure 3). The fish that were larger at release were also recovered at a slightly greater rate than were the smaller fish (mean length at release of recovered fish = 63.5mm).

Results - Freeze Brands

Freeze branding began on June 5 and was concluded on June 13. An "arrow" brand character was used to mark the fish and a unique mark was used each day. Arrow brands were located on the left and right anterior of the fish only and all four brand rotations were used during the eight days of marking. A total of 10,190 fish were branded (Table 7). Direct mortality due to the freeze branding was estimated at 1.6%. Two groups of 100 fish from the June 11 and June 13 release groups were held for 24 hour delayed mortality evaluation. Delayed mortality for these fish ranged from 2.0% to 8.0% and averaged 5.0%. The mortality rate may have been influenced by the capturing method and appeared to be higher

for fish that were captured by beach seine rather than by stick seine (Joe Hymer, WDF - personal communication).

A total of 84 freeze branded wild subyearling chinook were sampled at the juvenile collection facility. The first recovery of a freeze branded fish was on June 10. Daily passage peaked on July 12 and the last recovery of a branded fish was on December 1. Only 8.8% of the number of fish which were branded are estimated to have passed through the bypass system (Table 7). An additional 0.7% are estimated to have passed over the spillway.

The size of the branded fish at recovery ranged from 78mm to 192mm and averaged 101.2mm. The fish grew throughout the collection period and the average fork length increased during each successive month of sampling (Figure 4).

The recovery rate was highest for fish with arrow brands in the first rotation and lowest for fish with arrow brands in the second rotation (Table 7). Apparently second rotation brands were often mistaken for brands in the first rotation when the fish were examined at the facility.

Discussion

PIT Tags versus Freeze Brands

The peak arrival time and passage pattern were very similar for fish with the two different types of marks (Figure 5). However, the branded fish were recovered at a much lower rate than were the PIT tagged fish (Tables 6 and 7). This is most likely due to some branded fish being missed during the sampling and examination process. Generally, the brand quality was marginal. Some brands were very light and the 1/8" arrow character was a poor choice for this program as the this character did not always leave a distinct legible mark on the fish.

Overall, the mortality rate due to handling and marking was fairly low for both groups of fish although the freeze branded fish did have a higher mortality rate than the PIT tagged fish (6.6% versus 4.7%). This could have contributed to the overall lower recovery rate of the branded fish. In addition, relatively small numbers of branded fish were sampled each day and used to estimate the daily collection totals. The use of such small daily sample sizes to extrapolate daily collection and passage index estimates could have resulted in an under estimate of the actual number of branded fish entering the bypass system. It is not known how the placement of a visible external mark on a small fish changes the susceptibility of that fish to predation but this is one other factor which potentially could have lowered the recovery rate of the branded fish.

Priest Rapids Hatchery Fish versus Wild Fish

The peak passage date (July 12) for "U" branded upriver bright subyearling fall chinook which were released from Priest Rapids hatchery was essentially the same as that of the marked wild fish (July 12 - freeze brands, July 13 PIT tags). Figure 6 illustrates the median release dates for marked hatchery and wild fish as well as the arrival timing of the 10th, 50th, and 90th percentiles of the respective marked populations to McNary Dam. Marked hatchery fish were released later but generally passed McNary Dam before the marked wild fish. In addition, only a portion of the total number of wild fish which were captured each day was large enough to mark (had fork lengths equal to or greater than 55mm). It was anticipated that the markable proportion of wild fish would increase as the fish grew during the nine day marking period. However, this general trend was not observed. This was most likely because the proportion of larger fish that were captured each day was influenced not only by growth but also by the method and location of capture. Records were kept detailing the number of fish which were handled for the SMP marking program and these indicate that 39.5% of the fish that were handled were large enough to mark. This means 60.5% of the wild population which outmigrates from the Hanford reach was not represented at all by the SMP marking program. The PIT tag recovery data indicates that the fish that were smallest at the time of release generally arrived last (Figure 3). It is possible that much of the McNary Dam subyearling chinook collection which arrived in August through December was composed of wild fish that were to small to be marked in June and were therefore not represented by mark recoveries.

The branded hatchery fish passed McNary Dam at a much higher rate (24.1% of release) than the branded wild fish (9.5% of release). The quality of the "U" brands was much better than that of the arrow brands and "U" brands were probably missed less often. Branded hatchery fish also passed McNary Dam at a higher rate than PIT tagged wild fish (17.1% of release). Detection of PIT tags has been demonstrated to be close to 100%. It must be concluded that marked hatchery fish entered the collection system at McNary Dam at a greater rate than their wild counterparts. There are three likely reasons for this: 1) Predation - The hatchery fish were larger at release (Average Lengths: Hatchery- 95.2mm, Wild - 62.3mm) and should have therefore been better able to avoid predation. The marked hatchery fish were also released later (Release Dates: Hatchery -June 14 through June 26, Wild - June 5 through June 13) but were recovered earlier and were exposed to predation for a shorter duration of time. 2) Inriver Passage Conditions - The wild fish arrived later and experienced inriver passage conditions which were generally characterized by decreased flow and increased water temperature (Figure 7). 3) FGE - The fish guidance efficiency of the standard length submersible traveling screens currently in use at McNary Dam has been demonstrated to drop dramatically during the

subyearling chinook outmigration (Figure 9). Therefore although the collection estimates and resulting passage index estimates for wild fish may be low relative to hatchery fish it is possible that a higher proportion of wild fish may have passed under the traveling screens and through the turbines.

Conclusions

Late migration in warming water and declining flows translates to a reduced probability of recovery at McNary Dam. Marked wild zero age upriver bright fall chinook arrived later and were recovered at a lower rate than were their counterparts from Priest Rapids hatchery. In addition, the smallest marked wild fish generally arrived last. Most of the subyearling chinook which were handled for the SMP marking program were too small to be marked and these fish may have been the latest arrivals and may have been exposed to the poorest outmigration conditions of all. The results of this study are based upon a very small mark sample size relative to the population of wild juvenile fall chinook which inhabit the Hanford Reach. However, these results do suggest that improved inriver passage conditions for wild summer migrants would be beneficial.

1.0 BRAND RECOVERY QUALITY CONTROL

As in past seasons, yearling chinook, steelhead, and subyearling chinook were branded, held for 48 hours, and released back into the sample tank to check the brand recovery efficiency of the McNary SMP. Overall, the brand recovery rates were 96.2% for yearling chinook, 93.3% for steelhead, and 99.3% for subyearling chinook (Table 8). In the spring, an additional 75 run of the river branded yearling chinook, sockeye, and steelhead were caudal clipped and released back into the sample tank as an additional quality control check. A total of 71 of these were recovered for an overall recovery rate of 98.7%.

In 1990, all new SMP fish handlers were required to sort an entire B tank sample "seeded" with test branded fish. This was done to train the technicians/biologists to observe freeze brands and to verify that branded fish were not being missed at a high rate by new fish handlers. This year only one new fish handler was added to the McNary SMP crew and this person was required to sort a sample seeded with branded yearling chinook. She recovered 95% of the test branded fish.

Also in 1990, numerous test branded fish which had been released back into the B sample tank were recovered one or more days after the seeded sample was processed. It was determined that sample fish were escaping through the worn B tank crowder bristle brushes. Both the A and B tank crowders were re-lined and this eliminated the problem in 1990. Test branded fish did not circumvent either crowder in 1991.

5.0 COUNT DISCREPANCIES AND MISCELLANEOUS

Kokanee

This year a total of 1,065 fish which were counted in the total collection estimate for sockeye were actually kokanee. Most of the kokanee which arrive at McNary Dam apparently originate from Lake Roosevelt as sockeye 200mm in fork length or greater are also observed at Rock Island Dam (Chuck Peven, Chelan County PUD - personal communication) and at Priest Rapids and Wanapum Dams (Chris Carlson, Grant County PUD - personal communication). Kokanee sampled at McNary ranged from 290mm to 405mm and had a mean fork length of 281.2mm (Figure 9). Kokanee composed 0.3% of the total sockeye collection in 1991.

Rainbow

A total of 3,915 or 1.1% of the 1991 hatchery steelhead collection was actually rainbow trout. Rainbows were distinguished from hatchery steelhead by morphological characteristics and ranged from 200mm to 370mm with a mean fork length of 260.6mm (Figure 10). Floy anchor tagged rainbow trout have been recovered at McNary Dam each season since 1989. These fish are part of a Colville Indian Nation/Eastern Washington University cooperative enhancement program on Lake Roosevelt. It is likely that most of the rainbow trout observed at McNary originate from this program. Rainbows and kokanee are apparently flushed out of Lake Roosevelt during extreme drawdowns at Grand Coulee Dam (Dr. Al Scholz, Eastern Washington University-personal communication).

Yearling Chinook

In November and December a total of 105 yearling chinook which were reported to have been collected and bypassed were actually mature subyearling mini-jacks. The age of these mini jacks was verified through scale analysis. Mature zero age chinook had not been observed at McNary Dam prior to November of 1991 and the origin of these fish is unknown. Subyearling mini-jacks ranged from 112mm to 187mm and had a mean length of 159.7mm. Most (77.8%) of the yearling chinook collection reported in November and December was subyearling mini-jacks. Zero age mini-jacks were a negligible component of the overall 1991 yearling chinook March through December collection estimate, however.

Miscellaneous

This year one juvenile atlantic salmon was sampled at McNary Dam and ten were estimated to have been collected. Two others were observed in the raceways. Atlantic salmon had not been observed at McNary Dam prior to 1991 and these apparently escaped from a

net pen rearing program at Rufus Woods Lake. Several atlantic salmon were also observed at Rock Island Dam this past spring (Chuck Peven, Chelan County PUD personal communication). The one atlantic salmon which was measured at the McNary facility this year had a fork length of 169mm.

Two dolly varden also entered the sampling system this year and the expanded collection estimate for these fish was thirteen. Lengths were not recorded for dolly varden.

Observations of atlantic salmon and dolly varden were reported in the "comment" section of the daily report but were not included in the daily collection numerical summary.

6.0 MONITORING IN NOVEMBER AND DECEMBER

This year a WDF evaluation of adult passage through the juvenile bypass system was conducted after November 1 when the submersible traveling screens would normally be removed for maintenance. The screens remained installed through December 16 for the fallback evaluation and the smolt monitoring program was conducted concurrently. The A side of the juvenile separator was covered during the evaluation and all juveniles were routed through the B exit. All sample fish were diverted to the B tank and the remainder of the collection was bypassed. The PIT tag detection system remained operational throughout the evaluation.

The 24 hour sample rate ranged from 10% to 24% and was adjusted in response to the debris load and to the abundance of juvenile american shad. The B sample tank has only one water elimination screen which often became plugged during periods of heavy debris load. This problem was minimized by lowering the sampling rate. Juvenile american shad abundance was high throughout November and these small fish had to be dip netted by hand from the sample tank and then bypassed. Shad were not counted but the collection appeared to peak during the second week of November. During this time it was roughly estimated that over 100 pounds of shad were loaded into the B tank in one 24 hour sampling period.

Daily sampling in November and December was usually conducted by one person due to the relatively small number of salmonids. The re-circulating anesthetic system was seldom operated and the sample trough was usually filled via the emergency freshwater inflow. Sample fish were pre-anesthetized and carried into the lab building where they were counted and examined for scale loss and freeze brands. The processed fish were then allowed to recover in a five gallon bucket of fresh water and then carried to the lower end of the ice and trash sluiceway and released.

Most of the fish which were sampled were subyearling chinook. Overall only 0.5% of the 1991 subyearling collection total was counted in November and December. However, subyearling chinook

abundance was higher in November during the normal post screening period than during either of the final two months (September and October) of the normal screening season (Table 9).

Subyearling chinook averaged 165.3mm in fork length in November and December and ranged from 105mm to 250mm (Figure 11). Fish with fork lengths near the lower end of the size range displayed in Figure 11 appeared morphologically different from other subyearlings and may have been zero age spring chinook. Subyearling chinook grew rapidly throughout the collection season (Figure 12).

The subyearling chinook descaling rate increased from a season average of 1.1% (March - October) to an average of 6.0% in November and December. The descaling rate increase may have been due to frequent debris blockages in the E tank counter tunnel.

The sample tank mortality rate was very low in November and December and averaged 0.6%. Post sampling/handling mortality data was not collected because all sample fish were bypassed shortly after they were examined. System mortality averaged only 0.1% in November and December. However, this does not accurately reflect the mortality rate for the entire collection. System mortality is calculated by dividing the number of mortalities counted each day by the daily collection estimate including that portion of the daily collection which is bypassed. Most of the collection in November and December was immediately bypassed and the only mortalities which were counted were those from the sample tank.

Three freeze branded subyearling chinook were sampled in November and December. These fish originated from Priest Rapids hatchery (fall chinook), Wells hatchery (summer chinook), and the Hanford Reach (wild fall chinook). One PIT tagged wild subyearling fall chinook from Hell's Canyon on the Snake River was also detected in November.

7.0 LAKE WENATCHEE NET PEN SOCKEYE

A total of 260,400 juvenile sockeye salmon were reported to have been released from Lake Wenatchee net pens in October of 1990. Sockeye scale samples were taken in the spring of 1991 by the McNary SMP to identify these fish. Net pen sockeye which were sampled at McNary Dam averaged 122mm in fork length and ranged from 110mm to 136mm. Double extrapolations of length frequency data and scale sample data were used to estimate the composition of the sockeye collection from April 30 through June 4. Net pen sockeye were estimated to compose 13.0% of the total sockeye collection and 19.9% of the yearling sockeye collection which originated from Lake Wenatchee (Table 10).

Approximately 1% of the Lake Wenatchee brood were used to produce

the net pen fish. The collection estimates are based upon double extrapolations from relatively small samples and are rough. However, they do suggest that sockeye originating from the net pen program did survive to reach McNary Dam at a much higher rate than wild Lake Wenatchee sockeye.

8.0 RECOMMENDATIONS

1. The WDF Fallback Evaluation provided the unique opportunity for smolt monitoring to be conducted at McNary Dam in November and December when the submersible traveling screens would normally be removed for maintenance. Two important observations were made during this time period:

A. More smolts were collected in November (normal post screening period) than in either September or October (normal screening period).

B. One PIT Tagged wild subyearling fall chinook from the Snake River was detected during November when the submersible traveling screens would normally be removed. Wild Snake River fall chinook are currently proposed for listing as "threatened" under the Endangered Species Act.

The screening season should be extended and a late season transportation program should be initiated to provide maximum protection for these fish. If these two measures are implemented, then the McNary Smolt Monitoring season should be continued concurrently.

2. Considerable emphasis is placed upon providing flow augmentation in the Snake and Columbia River basins to aid yearling spring outmigrants. However, most of the juvenile salmonids which pass McNary Dam are subyearling chinook which arrive during the summer. Production estimates have been calculated in past years and these indicate that most of the subyearling chinook present in the Columbia River above McNary Dam are wild fish which originate from the Hanford Reach.

Only a small portion of the wild subyearling fall chinook population which inhabits the Hanford Reach was marked this year to index arrival timing to McNary Dam. In addition, most of the captured wild fish were too small to mark and were therefore not represented at all by mark recoveries. Given the limitations of this small scale pilot study, the results indicate that wild subyearlings: 1) arrived at McNary Dam later than their hatchery counterparts, 2) experienced deteriorating inriver passage conditions, and 3) were recovered at a lower rate than hatchery fish. These results suggest that a summer flow augmentation program would benefit wild summer outmigrants.

This study should be repeated in 1992 to provide data comparable

to that collected in 1991. The freeze branding tool used in 1992 should be a 1/8" open single character (i.e., "C", "J", "L", "S", etc.) which will produce a more legible mark than the "arrow" character used in 1991.

Expanding the use of PIT tags to mark wild subyearlings in the future should also be considered.

3) This year one group of subyearling chinook which were reported to have been branded on the right side at McNary Dam and bypassed were determined through subsequent recoveries at John Day Dam to have been branded on the left side. Potentially an error such as this can hopelessly confound travel time estimates. Steps will be taken in 1992 to eliminate this type of error. These will include:

A) The freeze branders will be watched more carefully while they brand fish.

B) An illustration showing the direction the fish is to be held while it is branded will be included on the branding pot label to aid the freeze branders.

C) One brand label will be removed from a branding pot and attached directly to the daily marking record form to eliminate the possibility of transcription error.

D) Fish that are checked for 48 hour delayed mortality will also be checked for proper brand placement.

TABLES

Table 1. 1991 McNary Dam mortality summary.

Year	System Mortality	Sample Tank Mortality	Raceway 1 Mortality Index	Control Tank Mortality
1987	2.6%	2.8%	Ø.9%	-----
1988	1.7%	1.5%	Ø.4%	-----
1989	1.Ø%	2.4%	Ø.4%	-----
199Ø	1.2%	1.5%	Ø.3%	-----
1991	1.Ø%	1.8%	Ø.4%	Ø.6%

Table 2. 1991 Full sample descaling summary (March - December).

	CH-1	CH-Ø	SH-W	SH-H	COHO	SOCK	TOTAL
# Sampled	16Ø,832	314,14Ø	7,5Ø5	37,81Ø	9,729	23,27Ø	553,286
# Descaled	14,Ø31	13,958	315	3,883	79Ø	2,525	35,5Ø2
% Descaled	8.7%	4.4%	4.2%	1Ø.3%	8.1%	1Ø.9%	6.4%

Table 3. 1991 FPC travel time evaluation - daily marking record.

YEARLING CHINOOK		MARKED		XX	UNMARKABLE			XX	TOTAL HANDLED	
Date	Brand	Number Bypassed	Number Transported	Total XX XX	Branded	Descaled	Injured	Total XX XX	Total Handled	Percent Markable
April 22	LAIX1	1,180	20	1,200 XX	41	55	52	148 XX	1,348	89.0%
April 23	LAIX2	1,180	20	1,200 XX	60	65	63	188 XX	1,388	86.5%
April 24	LAIX3	1,180	20	1,200 XX	72	85	34	191 XX	1,391	86.3%
April 25	LDIX1	1,180	20	1,200 XX	65	101	116	282 XX	1,482	81.0%
April 26	LDIX3	1,126	20	1,146 XX	45	75	73	193 XX	1,339	85.6%
April 29	LA101	857	20	877 XX	18	65	66	149 XX	1,026	85.5%
April 30	LA102	1,637	0	1,637 XX	33	141	64	238 XX	1,875	87.3%
May 1	LA103	350	20	370 XX	14	29	30	73 XX	443	83.5%
May 2	LD101	935	20	955 XX	25	96	53	174 XX	1,129	84.6%
May 3	LD103	1,059	20	1,079 XX	25	95	39	159 XX	1,238	87.2%
May 6	LA151	1,680	20	1,700 XX	48	216	80	344 XX	2,044	83.2%
May 7	LA152	1,688	20	1,708 XX	89	450	114	653 XX	2,361	72.3%
May 8	LA153	1,687	20	1,707 XX	113	538	169	820 XX	2,527	67.6%
May 9	LD151	1,681	20	1,701 XX	143	479	212	834 XX	2,535	67.1%
May 10	LD153	1,682	20	1,702 XX	124	510	241	875 XX	2,577	66.0%
May 13	LAID1	1,180	20	1,200 XX	102	339	132	573 XX	1,773	67.7%
May 14	LAID2	1,308	20	1,328 XX	77	387	108	572 XX	1,900	69.9%
May 15	LAID3	1,623	20	1,643 XX	111	590	111	812 XX	2,455	66.9%
May 16	LDID1	1,305	20	1,325 XX	153	613	37	803 XX	2,128	62.3%
May 17	LDID3	1,180	20	1,200 XX	97	563	164	824 XX	2,024	59.3%
May 20	LAIF1	1,386	20	1,406 XX	92	327	130	549 XX	1,955	71.9%
May 21	LAIF2	1,391	20	1,411 XX	116	596	219	931 XX	2,342	60.2%
May 22	LAIF3	1,382	20	1,402 XX	87	482	134	703 XX	2,105	66.6%
May 23	LDIF1	811	20	831 XX	30	138	72	240 XX	1,071	77.6%
May 24	LDIF3	1,580	20	1,600 XX	52	285	120	457 XX	2,057	77.8%
		32,248	480	32,728 XX	1,832	7,320	2,633	11,785 XX	44,513	73.5%

Table 4. 1991 FPC travel time evaluation - daily marking record.

STEELHEAD		MARKED			UNMARKABLE				TOTAL HANDLED	
Date	Brand	Number Bypassed	Number Transported	Total	Branded	Descaled	Injured	Total	Total Handled	Percent Markable
April 29	RA131	448	20	468	2	21	41	64	532	88.0%
April 30	RA132	1,944	0	1,944	3	74	99	176	2,120	91.7%
May 1	RA133	149	20	169	1	6	11	18	187	90.4%
May 2	RB131	449	20	469	0	13	14	27	496	94.6%
May 3	RB133	502	20	522	7	8	5	20	542	96.3%
May 6	RA171	890	20	910	51	66	52	169	1,079	84.3%
May 7	RA172	890	20	910	50	83	77	210	1,120	81.3%
May 8	RA173	1,107	20	1,127	100	80	74	262	1,389	81.1%
May 9	RB171	1,178	20	1,198	65	76	90	231	1,429	83.8%
May 10	RB173	1,454	20	1,474	75	115	94	284	1,758	83.8%
May 13	RAIV1	881	20	901	183	57	71	311	1,212	74.3%
May 14	RAIV2	1,843	20	1,863	283	120	80	483	1,546	68.8%
May 15	RAIV3	1,808	20	1,828	237	117	82	436	1,464	70.2%
May 16	RBIV1	1,735	20	1,755	345	155	82	582	2,337	75.1%
May 17	RBIV3	1,806	20	1,826	250	149	126	525	2,351	77.7%
May 20	RAIM1	751	20	771	89	104	35	228	999	77.2%
May 21	RAIM2	1,107	20	1,127	196	100	80	376	1,503	75.0%
May 22	RAIM3	1,434	20	1,454	369	171	81	621	2,075	70.1%
May 23	RBIM1	373	20	393	88	60	13	161	554	70.9%
May 24	RBIM3	731	20	751	193	69	35	297	1,048	71.7%
May 27	RA151	472	20	492	73	88	35	196	688	71.5%
May 28	RA152	399	20	419	57	71	45	173	592	70.8%
May 29	RA153	293	20	313	53	57	34	144	457	68.5%
May 30	RB151	284	0	284	49	48	35	132	336	66.7%
May 31	RB153	166	0	166	36	59	31	126	292	56.8%
		21,414	440	21,854	2,863	1,967	1,422	6,252	28,106	77.8%

Table 5. Summary of 1991 subyearling chinook USFWS-WDF marking program at McNary Dam.

1st replicate

		MARKED				UNMARKABLE							48 HOUR DELAYED MORTALITY & TAG LOSS					
Date	CWT Code	Brand	Marked & Bypassed	Marked & Trans.	Total	Prev. Branded	Desc.	Under-Size	Other Unmark.	Total Unmark.	Percent Markable	Total Handled	#Held	#Morts	%Mort	#Lost Tags	%Tag Loss
June 20	27/11	LAR1	1,302	125	1,427	4	122	54	648	828	63.5%	2,247	125	0	0.0%	0	0.
June 21	27/11	LAR4	985	100	1,085	4	86	103	453	646	62.7%	1,731	100	0	0.0%	0	0.
June 22	27/11	LAR3	1,137	100	1,237	6	121	107	512	746	62.4%	1,983	100	0	0.0%	0	0.
June 23	27/11	LAR2	1,843	100	1,943	10	152	89	683	934	67.5%	2,877	100	2	2.0%	0	0.
June 24	27/11	RAR1	1,954	125	2,079	10	185	67	605	867	70.6%	2,946	100	0	0.0%	0	0.
June 25	27/11	RAR2	3,997	100	4,097	16	238	140	753	1,147	78.1%	5,244	100	0	0.0%	0	0.
June 26	27/10	RAR3	5,486	100	5,586	33	368	107	843	1,351	80.5%	6,937	100	0	0.0%	1	1.
June 27	27/10	RAR4	6,514	100	6,614	46	446	43	709	1,244	84.2%	7,858	100	0	0.0%	0	0.
June 28	27/9	RA2K3	4,992	100	5,092	61	286	63	478	888	85.2%	5,980	100	0	0.0%	0	0.
June 29	27/9	LA2P1	4,772	100	4,872	61	289	91	456	897	84.5%	5,769	100	2	2.0%	0	0.
June 30	27/9	RA2P1	1,859	100	1,959	37	95	30	152	314	86.2%	2,273	100	0	0.0%	0	0.
			34,841	1,150	35,991	288	2,388	894	6,284	9,854	78.5%	45,845	1,125	4	0.4%	1	0.

2nd replicate

		MARKED				UNMARKABLE							48 HOUR DELAYED MORTALITY & TAG LOSS					
Date	CWT Code	Brand	Marked & Bypassed	Marked & Trans.	Total	Prev. Branded	Desc.	Under-Size	Other Unmark.	Total Unmark.	Percent Markable	Total Handled	#Held	#Morts	%Mort	#Lost Tags	%Tag Loss
July 9	27/8	RA2V1	2,484	100	2,584	95	121	6	206	428	85.8%	3,012	100	0	0.0%	0	0.
July 10	27/8	RA2V3	3,358	100	3,458	113	216	26	294	649	84.2%	4,107	100	0	0.0%	0	0.
July 11	27/8	LA2V1	5,860	100	5,960	199	365	17	572	1,153	83.8%	7,113	100	0	0.0%	0	0.
July 12	27/7	LA2V3	7,015	100	7,115	175	378	3	474	1,030	87.4%	8,145	100	0	0.0%	0	0.
July 13	27/7	LA2S1	4,789	100	4,889	83	207	14	409	713	87.3%	5,602	100	1	1.0%	1	1.
July 14	27/6	LA2S3	1,718	100	1,818	32	107	1	273	413	81.5%	2,231	100	0	0.0%	0	0.
July 15	27/6	RA2S1	4,633	100	4,733	70	265	15	303	653	87.9%	5,386	100	0	0.0%	0	0.
July 16	27/6	RA2S3	5,349	100	5,449	84	249	5	398	736	88.1%	6,185	100	1	1.0%	0	0.
Total			35,296	800	36,096	851	1,988	87	2,929	5,775	86.2%	41,781	800	2	0.3%	1	0.

3rd replicate

		MARKED				UNMARKABLE							48 HOUR DELAYED MORTALITY & TAG LOSS					
Date	CWT Code	Brand	Marked & Bypassed	Marked & Trans.	Total	Prev. Branded	Desc.	Under-Size	Other Unmark.	Total Unmark.	Percent Markable	Total Handled	#Held	#Morts	%Mort	#Lost Tags	%Tag Loss
July 24	27/5	RA2K1	2,904	100	3,004	7	208	4	177	396	88.4%	3,400	100	1	1.0%	0	0.
July 25	27/5	LA2K1	2,626	100	2,726	9	144	1	171	325	89.3%	3,051	100	2	2.0%	0	0.
July 26	27/5	LA2K3	938	100	1,038	4	85	1	118	208	83.8%	1,238	100	1	1.0%	0	0.
July 27	27/5	RA9T1	2,495	100	2,595	37	261	3	339	640	88.2%	3,235	100	12	12.0%	0	0.
July 28	27/5	RA9T3	1,279	100	1,379	5	101	2	154	262	84.0%	1,641	100	1	1.0%	0	0.
July 29	27/5	LA9T1	1,247	50	1,297	2	86	1	74	163	88.8%	1,460	50	0	0.0%	0	0.
July 30	26/63	LA9T3	7,461	100	7,561	30	492	1	351	874	89.6%	8,435	100	1	1.0%	0	0.

able 5. - continued.

uly 31 26/63 LA2P3	4,363	100	4,463	XX	18	284	1	252	555	88.9%	5,018	XX	100	2	2.0%	0	0.0%
ugust1 26/62 RA2P3	3,934	100	4,034	XX	11	247	0	154	412	90.7%	4,446	XX	100	0	0.0%	0	0.0%
ugust2 26/62 RARH1	4,121	100	4,221	XX	20	211	0	274	505	89.3%	4,726	XX	100	1	1.0%	0	0.0%
ugust3 26/62 LARH1	3,673	100	3,773	XX	16	234	0	354	604	86.2%	4,377	XX	100	1	1.0%	0	0.0%
otal	35,041	1,050	36,091	XX	159	2,353	14	2,410	4,936	88.0%	41,027	XX	1,050	22	2.1%	0	0.0%

ROGRAM SUMMARY

MARKED			XX UNMARKABLE XX						XX 48 HOUR DELAYED MORTALITY XX & TAG LOSS					
Marked & Bypassed	Marked & Trans.	Total	XXPrev. XXBranded	Desc.	Under-Size	Other Unmark.	Total Unmark.	Percent Markable	Total Handled	XX	#Held	#Morts	%Mort	#Lost Tags	%Tag Loss
105,000	3,000	108,000	XX 1,298	6,649	995	11,623	20,565	84.0%	128,653	XX	2,975	28	0.9%	2	0.1%

Table 6. PIT tag summary.

	Tagged at Hanford	Direct Mortalities	24 Hour Delayed Mortality	Total Mortality	Detected at McNary	Passage Index
Number	2,048	53	2/100		312	356
Percent	100.0%	2.6%	2.0%	4.6%	15.2%	17.4%
Average Length(mm) at Release	62.3			60.9	63.5	

Table 7. Freeze brand summary.

Brand	LAAR1	LAAR2	LAAR3	LAAR4	RAAR1	RAAR2	RAAR3	RAAR4	Total
Release Date	June 5	June 6	June 8	June 9	June 10	June 11	June 12	June 13	
# Released	895	1,000	1,630	1,035	1,500	1,630	1,500	1,000	10,190
Direct Mortality	0.2%	0.2%	0.6%	3.1%	1.0%	3.3%	1.5%	1.4%	1.6%
24 hour Delayed Mortality						8.0%		2.0%	5.0%
Total Mortality						11.3%		3.4%	6.6%
Estimated Collection	207	27	129	113	199	45	105	72	897
Percent of Release	23.1%	2.7%	7.9%	10.9%	13.3%	2.8%	7.0%	7.2%	8.8%
Passage Index									968
Percent of Release									9.5%

Table 8. 1991 recovery rates for test branded fish.

Species	Number Released	Number Recovered	Recovery Rate	Minimum	Maximum
Yearling Chinook	419	403	96.2%	56.3%	100.0%
Steelhead	387	361	93.3%	77.8%	100.0%
Subyearling Chinook	138	137	99.3%	95.7%	100.0%

Table 9. 1991 McNary Dam collection summary (September 1 - December 16)

	CH-1	CH-Ø	SH-H	SH-W	Coho	Sock	Total
September	35	18,Ø22	28	Ø	1	154	18,24Ø
October	1Ø	6,626	16	12	Ø	12	6,676
November	115	18,52Ø	1Ø	Ø	Ø	3Ø	18,675
December (1-16)	2Ø	4,316	11	1	Ø	4Ø	4,388

Table 10. 1991 McNary Dam sockeye collection composition estimates (April 30 - June 4).

Stock	Wenatchee	Wenatchee	Wenatchee	Okanogan	Okanogan	Roosevelt	
Age	1+	1+	2+	1+	2+	2+	
Origin	Net Pen	Wild	Wild	Wild	Wild	Kokanee Plants	Total
Number	39,449	158,729	12,853	85,667	5,013	591	302,302
Percent of Total	13.0%	52.5%	4.3%	28.3%	1.7%	0.2%	100.0%
Percent of Wenatchee 1+	19.9%	80.1%					
Percent of Release	15.1%						

FIGURES

Figure 1. Marking & Ch--0 Collection

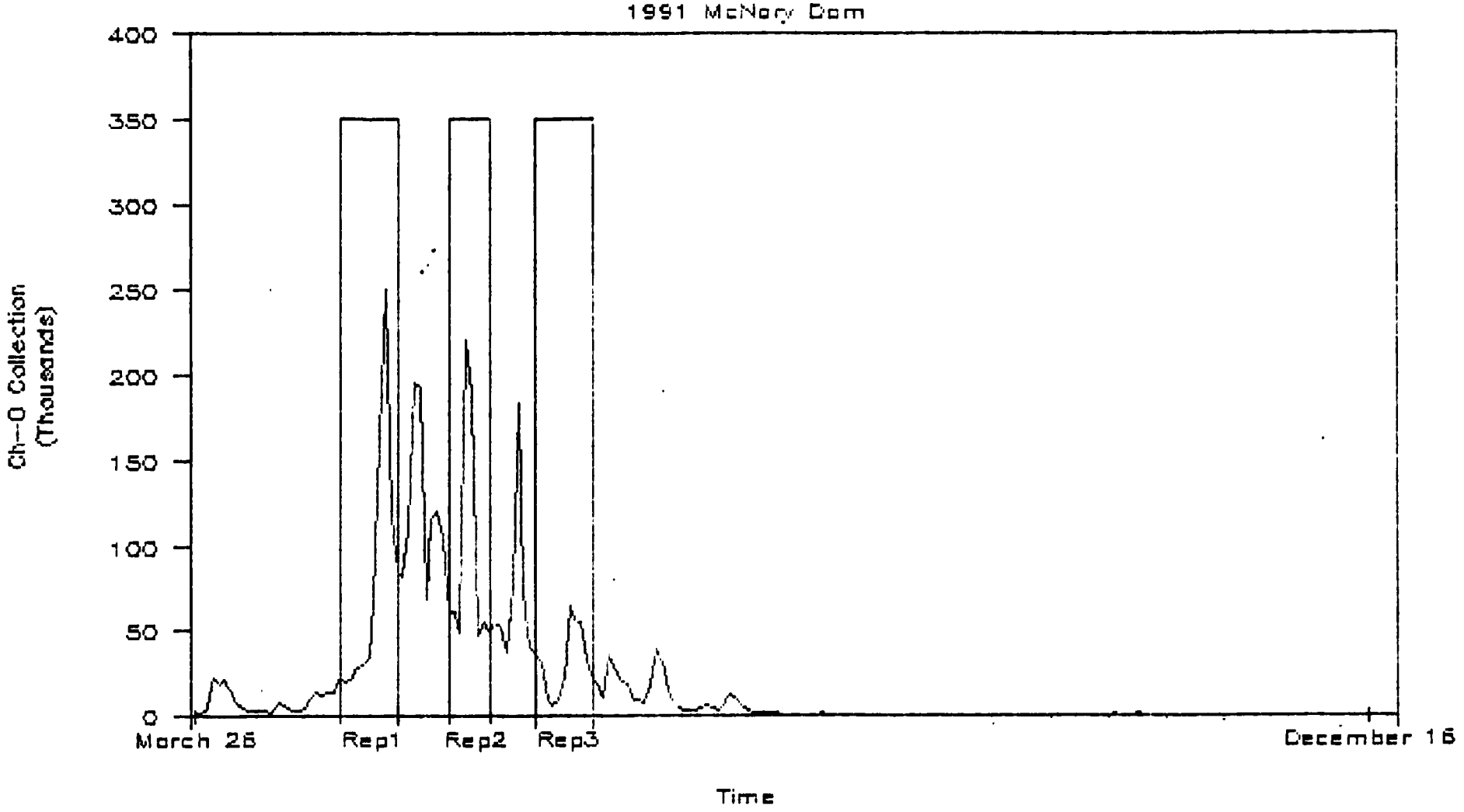


Figure 2. Length Frequency of Wild CH-0 at Release.

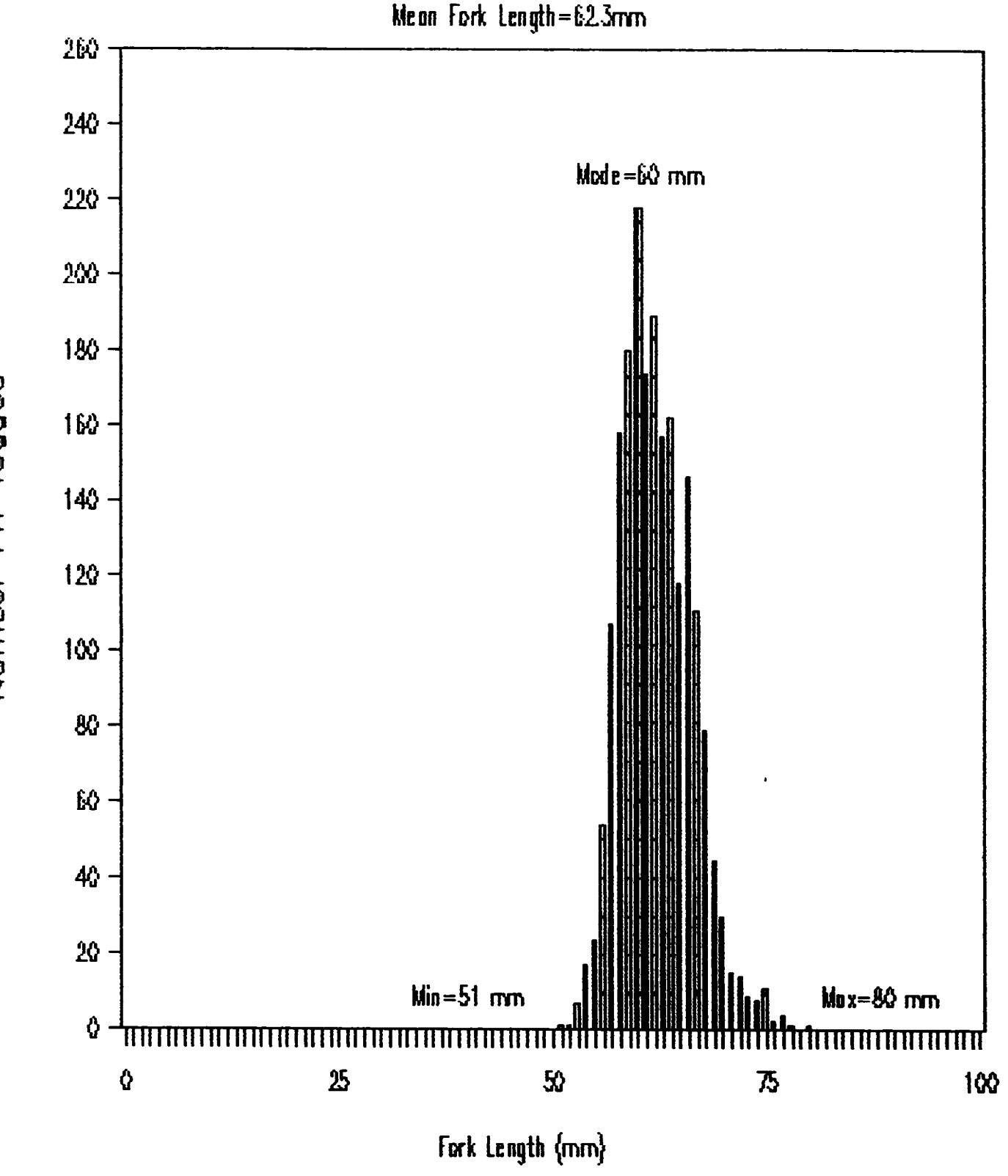


Figure 3. Average Size at Release and Arrival Timing.

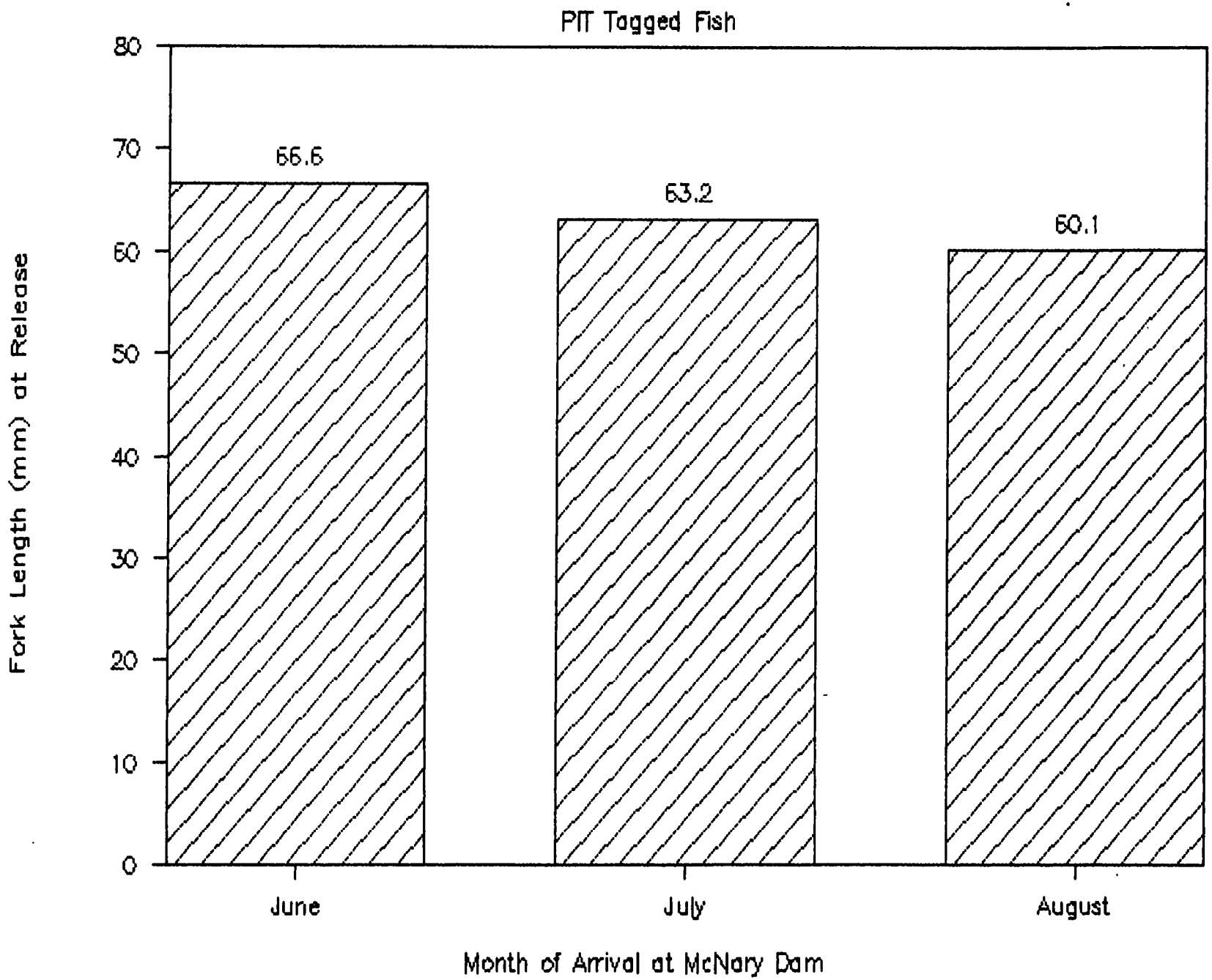


Figure 4. Average Size at Recovery.

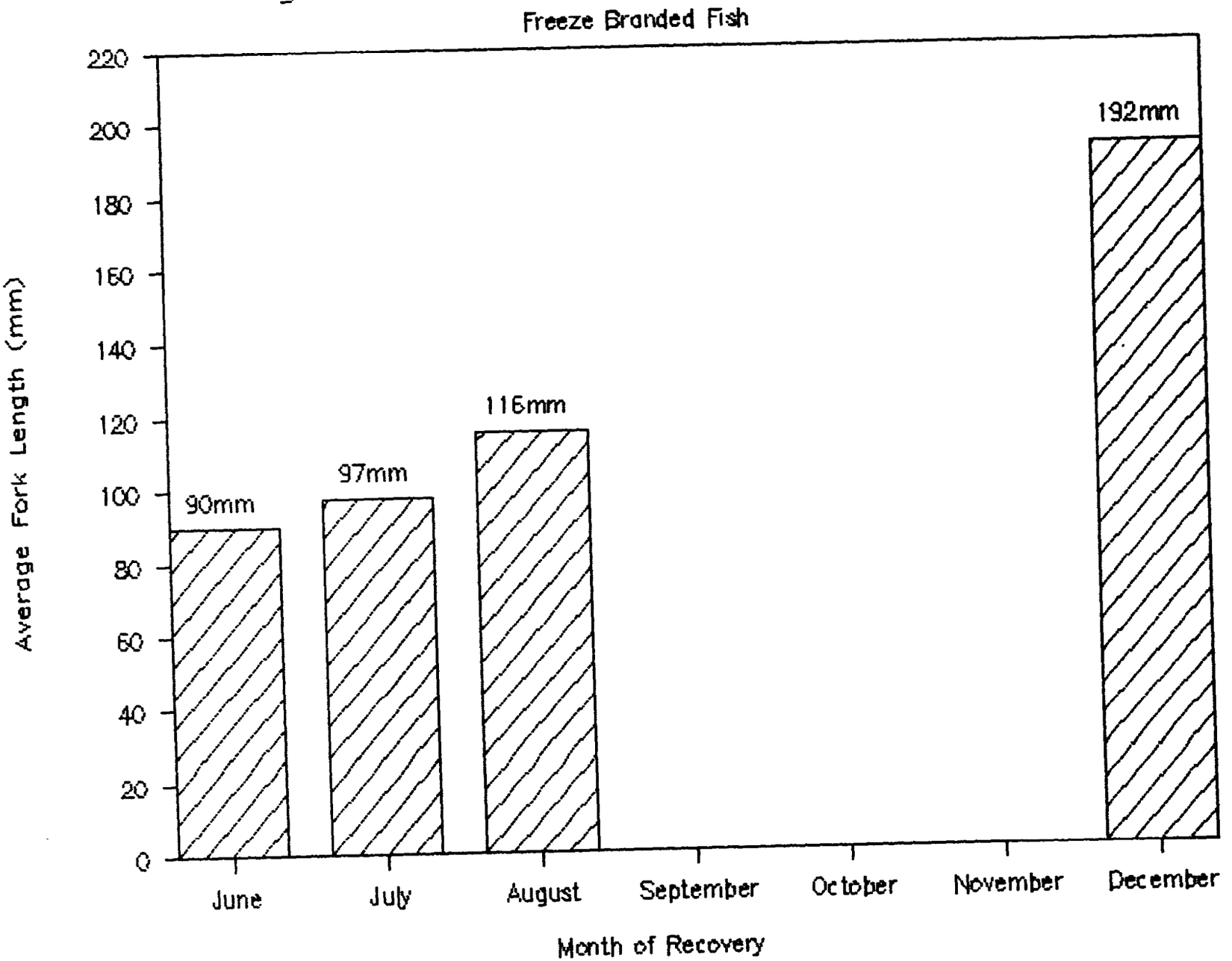


Figure 5. Arrival Timing.

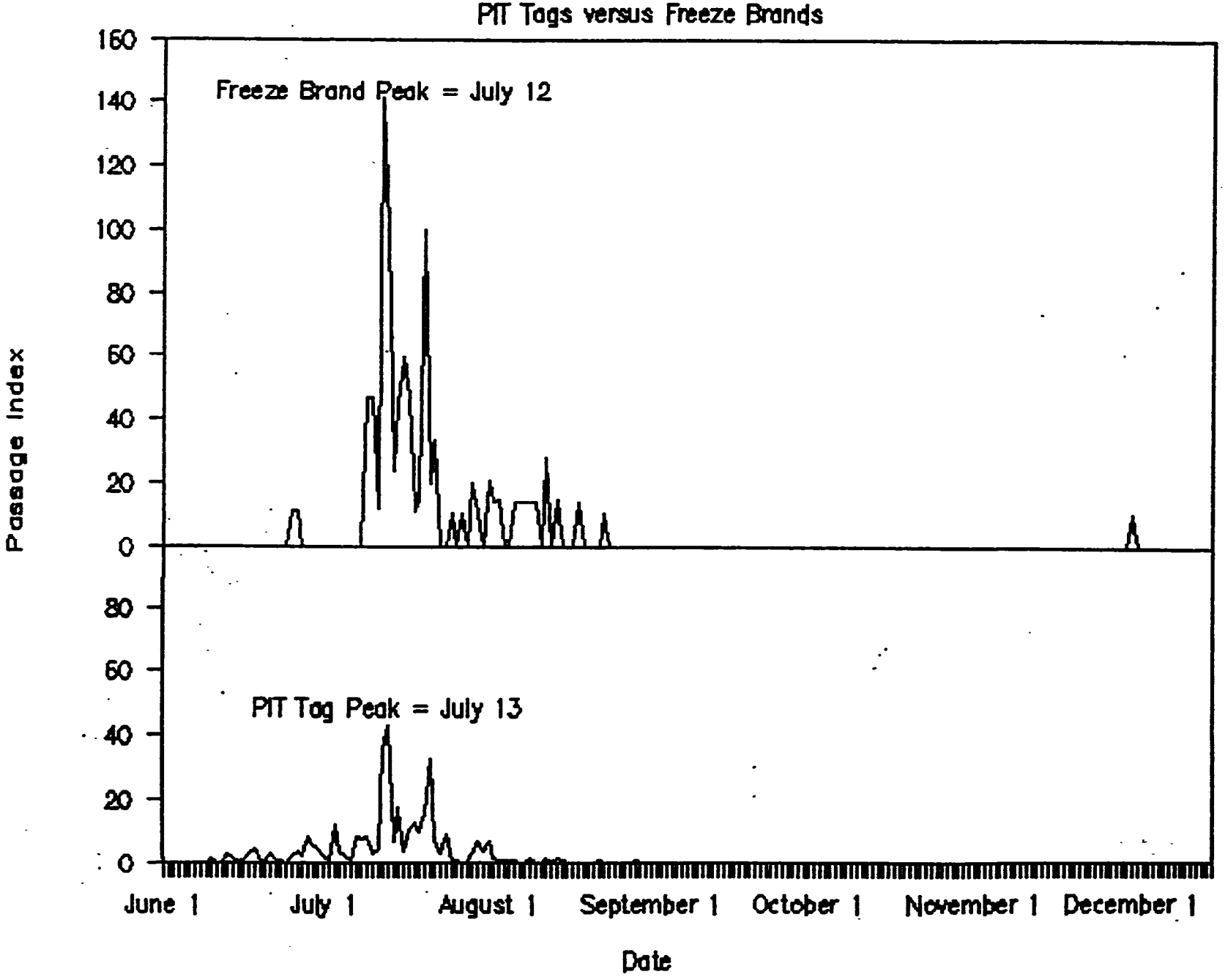


Figure 6. Release and Arrival.

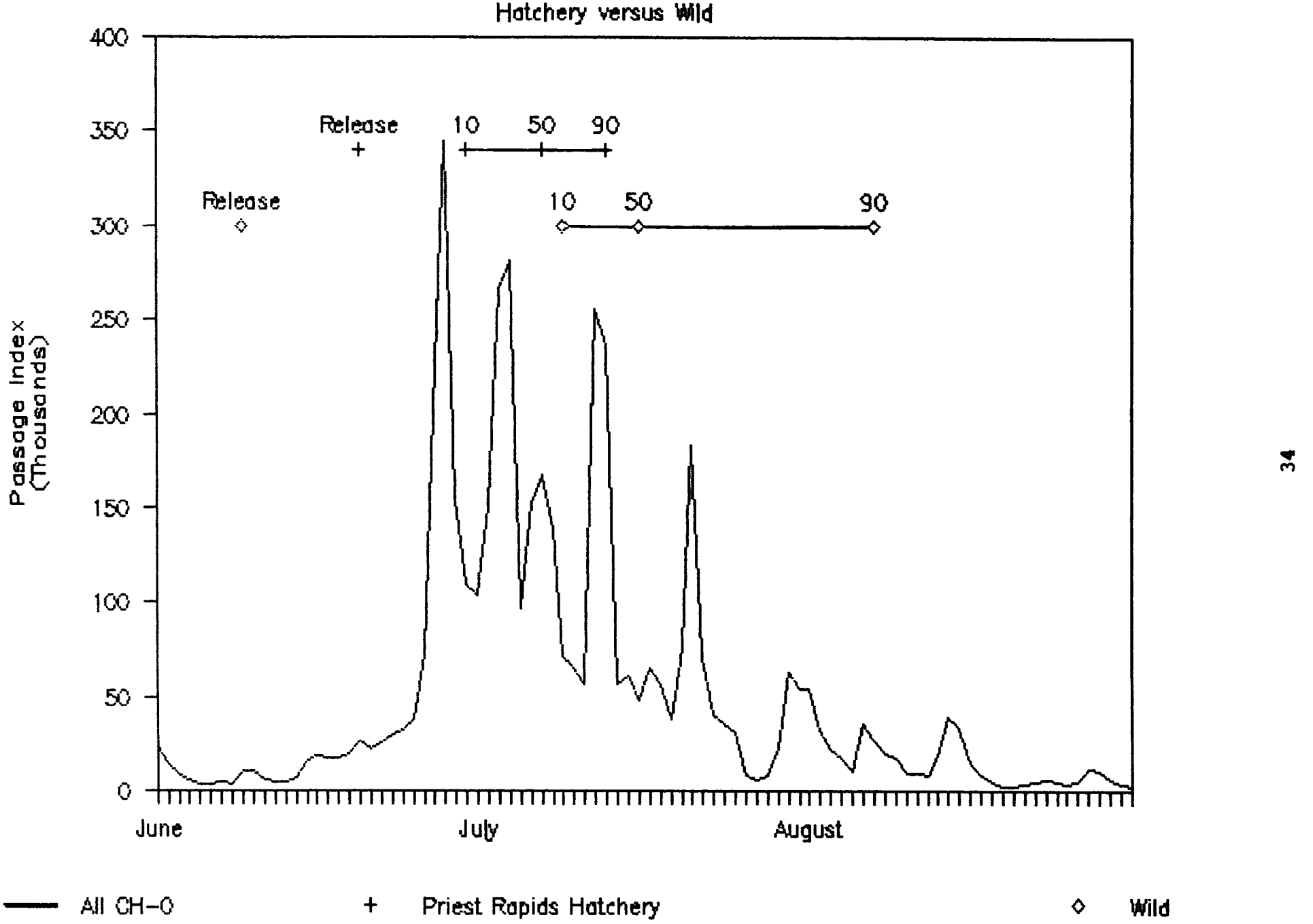
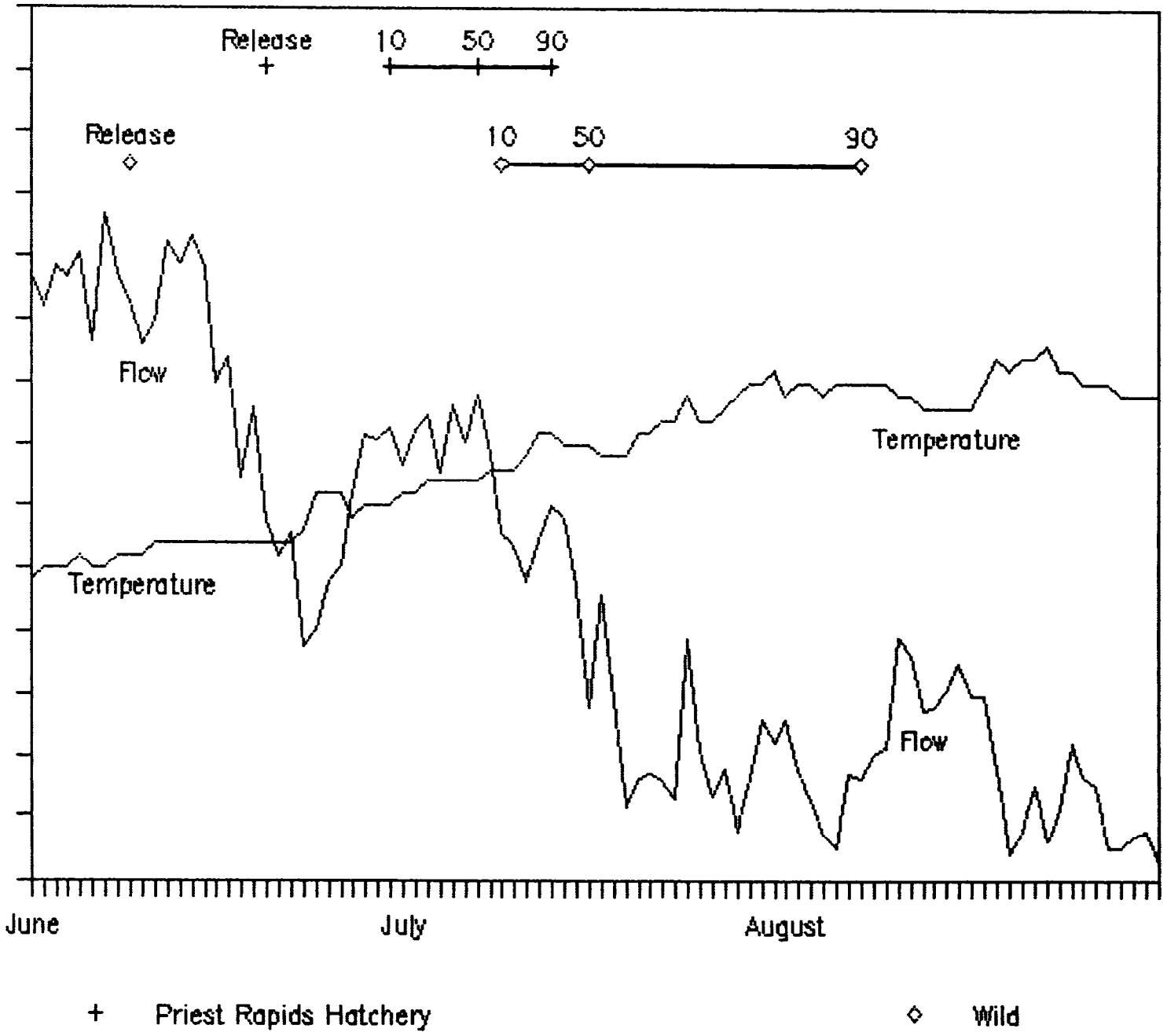


Figure 7. Arrival Time, Flow, and Temperature.



Not To Scale

Figure 8. 1987 Subyearling FGE at McNary Dam.

Adapted From Brege, Norman, Swan, Williams, 1988

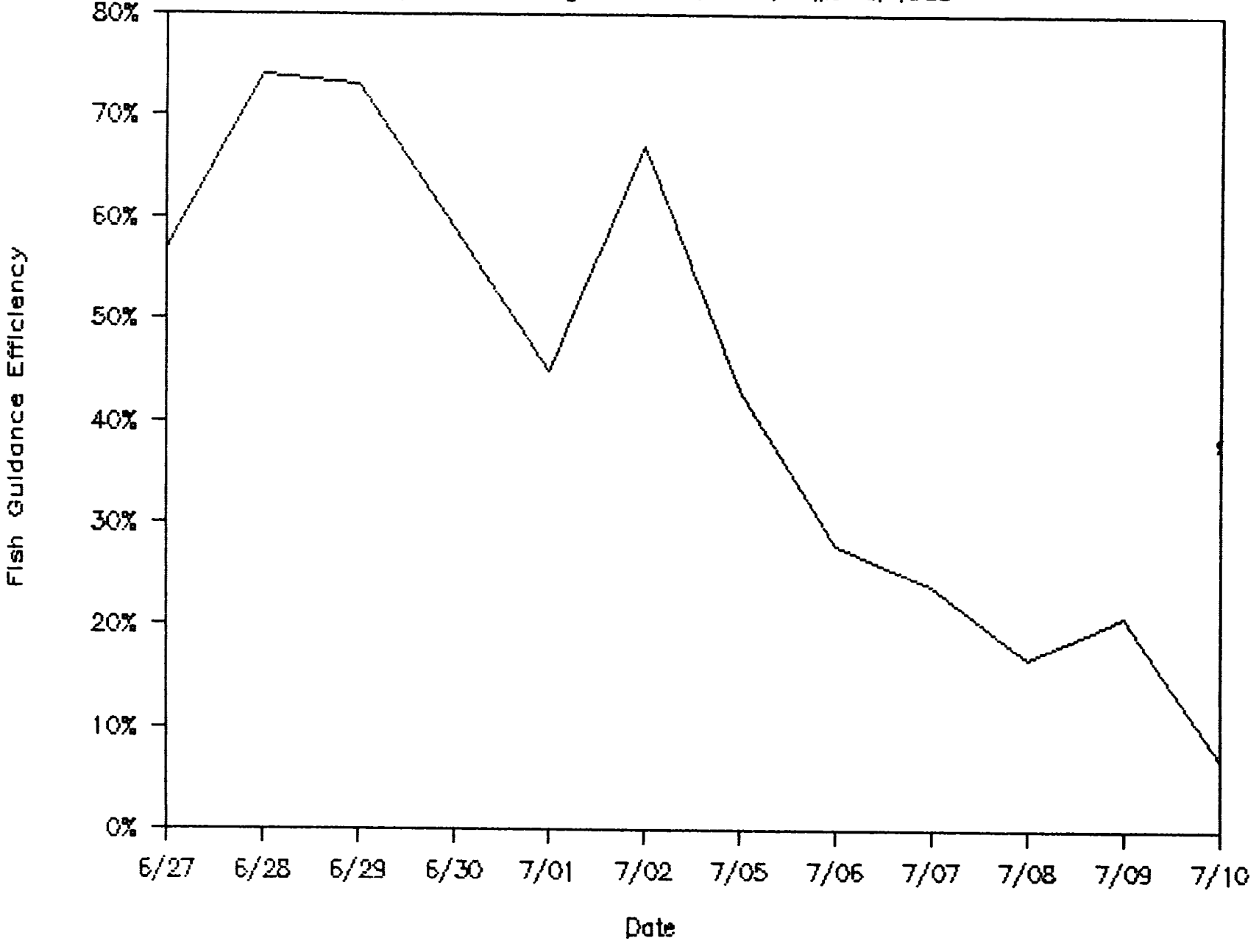


Figure 9. 1991 Kokanee Length Frequency.

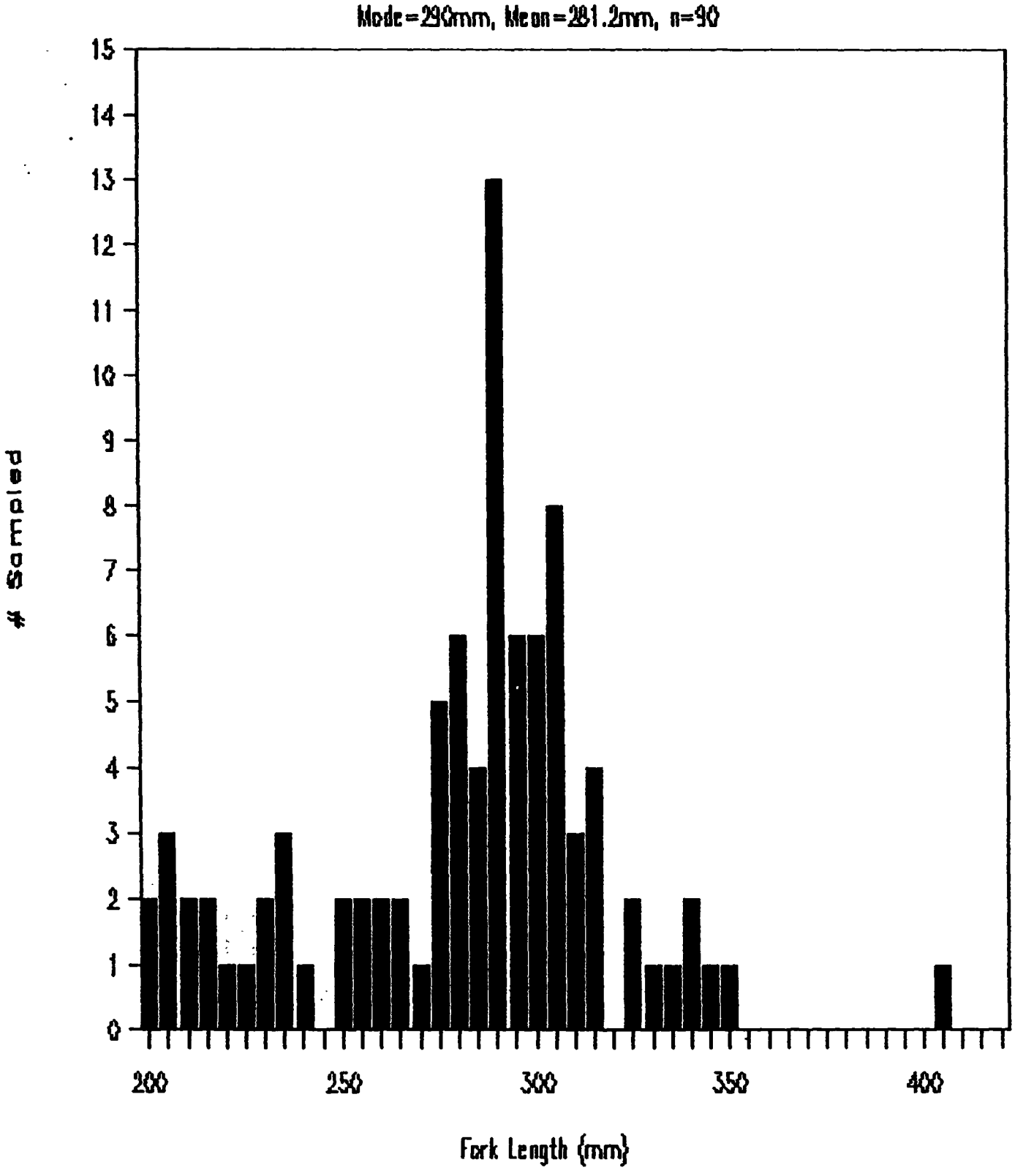


Figure 10. 1991 Rainbow Length Frequency.

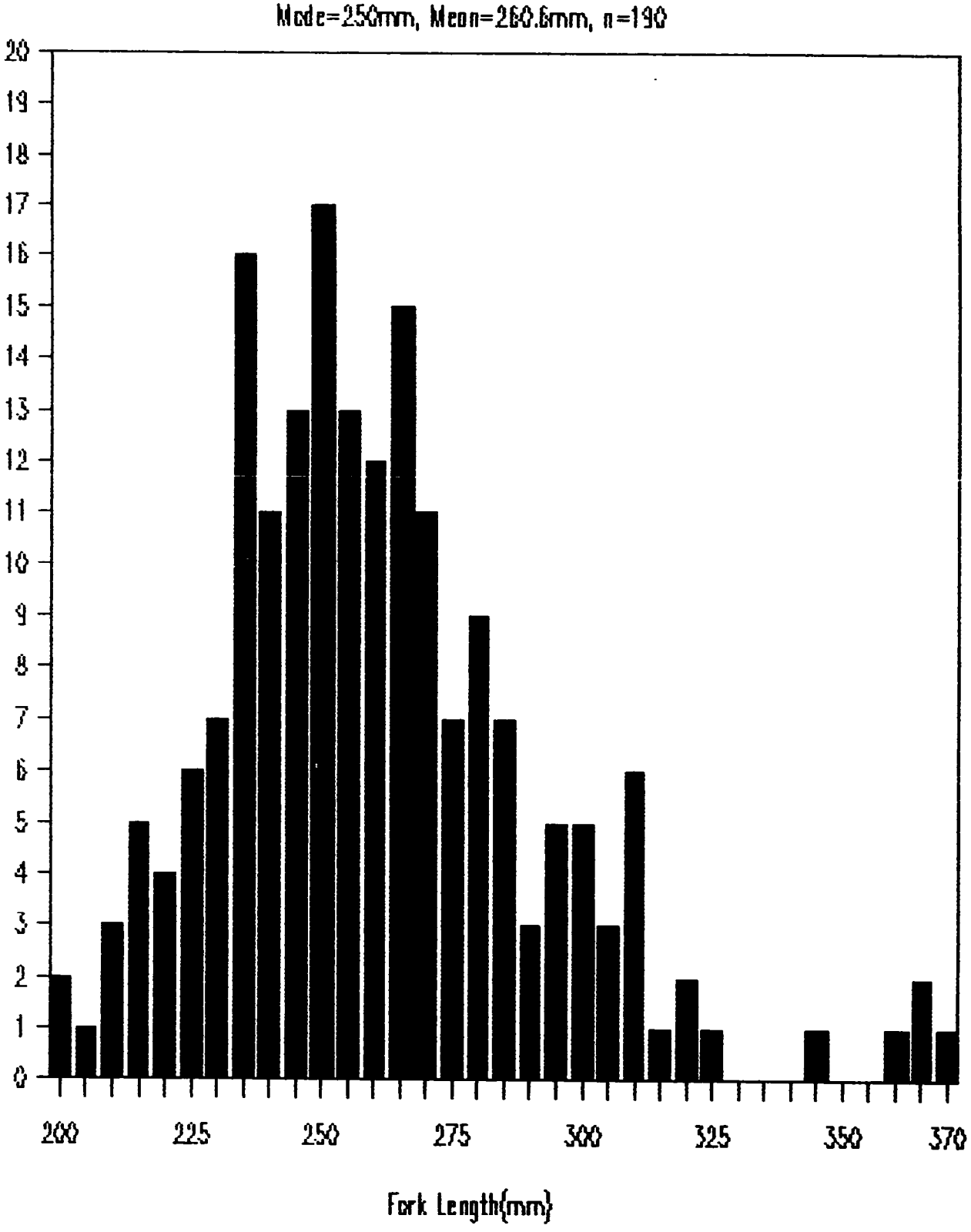


Figure 11. Subyearling Chinook Length Frequency.

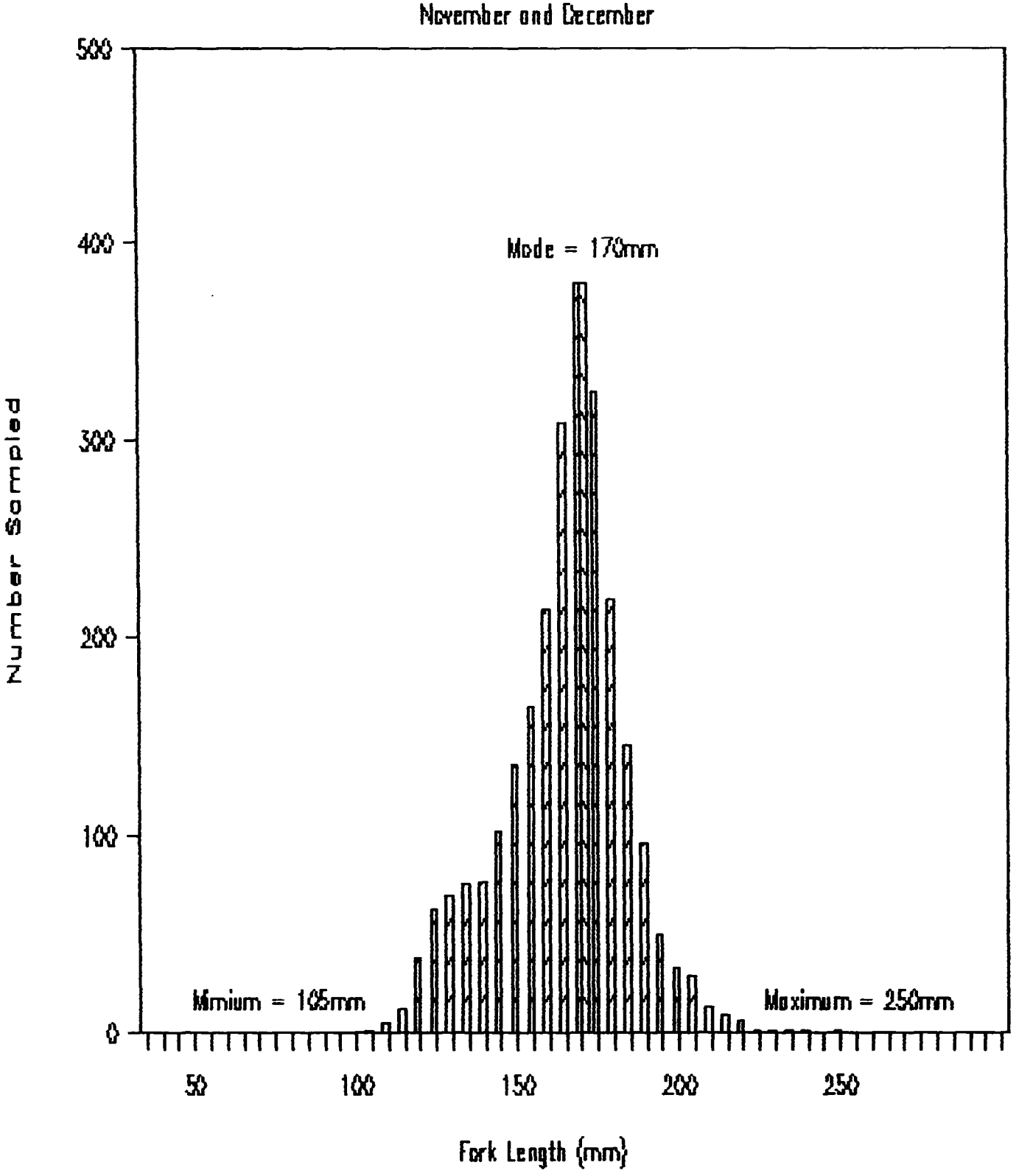


Figure 12. Average Subyearling Chinook Fork Lengths.